

论文

基于分形理论的水汽在燃煤细颗粒表面异质核化数值研究

颜金培, 杨林军, 凡凤仙, 沈湘林

东南大学能源与环境学院

摘要:

利用Fletcher模型对过饱和水汽在燃煤细颗粒表面异质核化特性进行了数值预测, 对不同粒径段燃煤细颗粒的形态进行扫描电镜(scanning electron microscopy, SEM)分析, 并用分形理论对细颗粒物的结构特征进行描述, 考察其对细颗粒异质核化性能的影响。结果表明, 实验用的燃煤细颗粒表面具有典型的分形结构, 分形维数在2.21~2.63; 燃煤细颗粒的不规则结构能使液滴胚胎形成临界吉布斯自由能降低、成核速率增大、核化所需的临界过饱和度降低, 可提高过饱和水汽在其表面的成核能力; 此外, 核化所需临界过饱和度随颗粒粒径增大而降低, 特别是小于0.1 mm的颗粒, 粒径对过饱和度的影响更为显著, 随温度提高核化所需的临界过饱和度相应降低。

关键词: 燃煤细颗粒 异质核化 过饱和 吉布斯自由能

Numerical Analysis of Water Vapor Nucleation on Fine Particles From Coal Combustion Based on Fractal Model

YAN Jin-pei, YANG Lin-jun, FAN Feng-xian, SHEN Xiang-lin

School of Energy and Environment, Southeast University

Abstract:

A numerical prediction of water vapor heterogeneous nucleation behavior on fine particles from coal combustion was carried out according to Fletcher's theory under the condition with and without considering the fractal characteristics of the fine particle. Microstructures of fine particles in different sizes were analyzed by scanning electron microscopy (SEM). Microstructures of fine particles were investigated using fractal model. The results show that it has a classical fractal structure of fine particles from coal combustion, with dimension between 2.21 and 2.63. The heterophilic properties of fine particles can reduce the Gibbs free energy of embryo formation and cause the magnitude of nucleation rate to increase dramatically and lead to an obviously reduction of critical supersaturation. Thus, the nucleation capabilities of supersaturated vapor are enhanced greatly for heterophilic particles. Moreover, critical supersaturation decreases with particles size, especially for those smaller than 0.1mm, and it seems a significant drop of critical supersaturation as the temperature increase.

Keywords: fine particles from coal combustion heterogeneous nucleation supersaturation Gibbs free energy

收稿日期 2008-08-07 修回日期 2008-12-15 网络版发布日期 2009-04-20

DOI:

基金项目:

国家自然科学基金项目(20576020); 国家重点基础研究发展规划基金项目(2002CB211604)。

通讯作者: 颜金培

作者简介:

参考文献:

本刊中的类似文章

文章评论 (请注意: 本站实行文责自负, 请不要发表与学术无关的内容! 评论内容不代表本站观点.)

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(OKB)
- ▶ [HTML全文]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 燃煤细颗粒
- ▶ 异质核化
- ▶ 过饱和
- ▶ 吉布斯自由能

本文作者相关文章

- ▶ 颜金培
- ▶ 杨林军
- ▶ 凡凤仙
- ▶ 沈湘林

PubMed

- ▶ Article by Yan,J.P
- ▶ Article by Yang,L.J
- ▶ Article by Fan,F.X
- ▶ Article by Chen,X.L

反馈人	<input type="text"/>	邮箱地址	<input type="text"/>
反馈标题	<input type="text"/>	验证码	<input type="text"/> 8140